

Geometric Solids: Geometric Gumdrops Galore

Brief Overview:

This is a four-day lesson to identify and practice using geometric solids. Students will identify the similarities and differences of two-dimensional and three-dimensional shapes. They will explore faces, edges, and vertices of eight geometric solids. After creating their own geometric solids, they will use different solids to create a model town.

NCTM Content Standard/National Science Education Standard:

Geometry

Grade/Level:

Third - Fourth

Duration/Length:

Four one-hour sessions

Student Outcomes:

Students will:

- Identify, compare, and analyze attributes of two and three dimensional shapes and develop vocabulary to describe the attributes
- Investigate, describe, and reason about the results of subdividing, combining, and transforming shapes
- Build and draw geometric objects
- Create and describe mental images of objects and recognize and apply them to other disciplines

Materials and Resources:

- Geometric solids to display and for student use
- Cubes for making prints with paint (use number cubes, paper cubes, etc.)
- Mystery box or bag
- Venn Diagram (student copies and teacher copy for display) (RS 1)
- Venn Diagram Sample Response (RS 1.b)
- Lesson 1 Exit Card (RS 2)
- Lesson 2 Response Cards (index cards) (RS 3)
- Geometric Solids Attribute Chart (RS 4.a.b)
- Geometric Solids Attribute Chart (RS 4.c.d)
- Lesson 2 Exit Card (RS 5)

- Finding Geometric Solids Homework (RS 6.a.b)
- Net Worksheets (RS 7 – 14)
- White paper to create cube prints and nets
- Scissors
- Glue
- Gumdrops
- Toothpicks
- Lesson 4 Building Illustration (RS 15)
- Summative Assessment (RS 16)
- Summative Assessment Rubric (RS 16.a)

Development/Procedures:

Lesson 1 Comparing 2-dimensional Shapes and 3-dimensional Figures

Preassessment – See Launch

Launch – Share objective with students. Introduce the “Mystery Bag.” Explain to students that you have placed an item in the bag and their job is to reach into the bag without looking and describe what they feel to their classmates. Use the cube, but name it “Item 1”. Have a few students come up and describe Item 1. Record student observations on chart paper or overhead. After descriptions, reveal the mystery figure. Have students check the accuracy of their descriptions. Observations should include but are not limited to: pointy, flat, square, six sides.

Teacher Facilitation /Student Application – Display the cube so that all students can see it. It is important to have the students make the connection between 2-dimensional shapes and 3-dimensional shapes at this point. Distribute paint trays with any color paint, plain paper, and cubes to each table. Model how to dip one face of the cube in paint and make a print on the paper. Have students complete this process. Have each student hold up their prints. Ask students, “What shape was made using the cube?” Students should be able to recognize that it is a square. Pose the question, “What would happen if you used a different side of the cube to make your print?” Collect paint materials, but leave clean cubes on desks. Distribute Venn Diagrams to each student (SR 1.a). On a larger model or overhead, write square on one side and cube on the other. Explain that they will be comparing the shapes. Ask students what is similar about the square and the cube, and what is different. The discussion should produce answers like: there are 6 squares in the cube, all sides are equal, the cube looks like a square in every direction, etc. Use the following questions to guide the discussion:

- What do we call shapes like the square?
- What shape takes up more space?
- Do both shapes have length?
- Do both shapes have width?
- Do both shapes have height?

If students have not generated the terms 2-dimensional and 3-dimensional, introduce them at this time. Explain that the square has length and width, but not height, and the

cube has all three. Complete the Venn Diagram. Explain to students that the parts of the cube they described earlier have fancy mathematical names. Without giving students the actual term, point to the “face” and ask, “What name would you give part of this cube?” Students can Think, Pair, Share responses. If face is not a response, reveal the term to the students. Have students write face in their journals. Continue the same process with edge and vertex. Have the students define each term in their own words. Below are the actual definitions of each term. Make sure that the student definitions resemble these:
Face: Polygonal regions that make up the surface of a solid or the flat side of a geometric solid.

Edge: The line where two faces of a geometric solid come together.

Vertex: A point where edges meet.

Have students write these definitions in their journals. You may also want to display terms on a Math Word Wall.

Embedded Assessment- Observe student responses throughout the lesson. At the end of the lesson, distribute Lesson 1 – Exit Card (RS2). Use student answers on Exit Card to guide instructions and groups for next lesson.

Reteaching/Extension –

- For those who have not completely understood the lesson, pull small groups and complete the same process with another solid, like a cone or a pyramid. Show them the faces and explain that 3-dimensional figures have length, width, and height. Use snap cubes to construct cubes.
- Provide different geometric solids for the students who understand the concept and have them identify the 2-dimensional figures they see. Students can also classify 2-dimensional and 3-dimensional figures.

Lesson 2 Identifying Solid Figures

Preassessment- Display the cube. Ask students to name it. Ask students if it is a 2-dimensional or 3-dimensional shape? How do they know? Pass out Lesson 2 Response Cards (RS 3), and explain to students that they will hold up the appropriate card as you point to it on the cube.

Launch – Share objective with students. Display the following geometric solids for all to see: cube, square and triangular pyramids, triangular and rectangular prisms, cylinder, sphere, and cone. Explain that these are other geometric solids and can be described just as the cube was using the terms, face, vertex, and edge. Identify solids by name.

Teacher Facilitation- Review the terms face, vertex, and edge (See Lesson 1 for definitions). Distribute cubes to students. Using an overhead of the Geometric Solids Attribute Chart (RS 4.a.b), model how to complete the chart using the cube. Include the number of faces, edges, vertices, as well as the shape of the faces, and where the solid can be found in everyday life. Make sure that students are pointing to and counting the correct areas as you write on the overhead.

Student Application- Explain to students that they will be completing the chart for different solids. Divide the class into cooperative groups using Lesson 1 Exit Card. Be sure to distribute students who showed mastery of Lesson 1 objective throughout the groups. You will rotate the shapes throughout the groups. Assign a different geometric solid to each group for Rotation 1. Be sure that all students get the opportunity to hold the figure. The number and size of your groups depends on the number of students in your classroom. Each student should complete his or her own chart for each solid, but should work as a group to generate answers. Explain to students that they do have the option of recording a different answer if they cannot agree, but they have to be able to justify their answers. Allow 3-5 minutes for each rotation. Bring students back together when finished. Share results on overhead. Be sure that all students have CORRECT information on their charts.

Embedded Assessment – Teacher should rotate through each group and observe student understanding of face, vertex, and edge. At the end of the lesson distribute Lesson 2 Exit Card (RS 5).

Reteaching/Extension-

- For those who have not completely understood the lesson, pull them aside and have them explore the different solids. With more direct instruction, count the faces, edges, and vertices of each solid. If students are struggling with identifying shapes, reference the following website:
<http://www.mathsurf.com/k/ch7msie/cone.html>
- For those who have understood the lesson, have them organize the solids according to their attributes and have them detect any patterns in the number of faces, edges, and vertices. Students can do this using the “Study the Shapes” and “Look for Patterns” buttons at the following website:
<http://illuminations.nctm.org/imath/35/GeometricSolids/GeoSolids3.html>

Lesson 3 Creating Nets from Shapes

Preassessment - Give clues about geometric solids the students have been learning about the last two days and have the students guess which solid you are describing.

- I have one circular face. I also have a curved surface. What geometric solid am I? Answer: cone
- I have six faces. All of my edges are the same length. Which geometric solid am I? Answer: cube
- I have an odd number of vertices. I have the same number of faces and vertices. Which geometric solid am I? Answer: square pyramid

Launch - The students will use the knowledge they gained about geometric solids the previous two days to create nets to share with their peers. The students will use the nets to create a model of each geometric solid.

Teacher Facilitation – The teacher will show one example of a net to the class. The example will be a cube. The teacher will explain that to create a net the students must draw all of the parts their classmates will need to successfully make the geometric solid. The teacher will model how to create the net. “A jacket for a geometric solid that can be folded to create the surface of the solid is called a net. A net is a way of representing a polyhedron in two dimensions” (nctm.org). While modeling, the teacher will remind the students that to create a correct figure they need to be thinking about the number of faces, edges, and vertices their shape has. The teacher will place a cube on a piece of paper. The teacher will trace the cube. The teacher will roll the cube forward once and trace the cube again. The teacher will roll the cube back to its original place. The teacher will roll the cube to the left once and trace the square. The teacher will roll the cube back to its original place. The teacher will roll the cube to the right once and trace the square. The teacher will roll the cube back to its original place. The teacher will roll the cube back once and trace the square. The teacher will roll the cube back once again and trace the square. The teacher has now drawn an outline of the cube. The cube will not yet work without tabs to glue or tape. The teacher will draw tabs on the top of the net and around the left and right parts of the net. The teacher will outline the outside edge of the net. That is what will be cut out. The inside lines will be folded to create the solid. The teacher will model cutting out and gluing the net into a cube.

Student Application – Put the students into groups to create the other nets. There will be six or seven groups. The students will create nets to make triangular pyramids, square pyramids, triangular prisms, rectangular prisms, cylinders, cones, and spheres. If there is a GT or advanced group they should get the sphere. It will be the most challenging geometric figure to create. Give each group a solid to use to create their nets. The teacher will walk around and help groups of students to create their nets. Ask questions to help them problem solve while drawing their nets.

- How many vertices does your net need?
- How many edges does your net need?
- How many faces does your net need?
- Where will you put the tabs?
- Will you have to make the net more than once to make it correctly?

After they have created the net for their figure have students create one of each of the other figures from worksheets already copied.

Embedded Assessment – Observe each student to see how he/she is progressing. Do they understand how many faces, edges, and vertices are needed to make their figure?

Reteaching/Extension –

- For those students and/or groups who do not understand how to create the solid figure show them a solid figure and ask them what they need to create the figure.
- Have them identify the faces, edges, and vertices in their figure.
- Help the students to move the figure and trace the parts to create the net.
- For those groups that have finished have them try to create another net for another figure.

Lesson 4 Using Geometric Solids to Create a Model Town

Preassessment – Give clues about geometric solids they have been learning about the past three days and have students guess which solid you are describing.

- I have two triangular faces. I have three rectangular faces. Which geometric solid am I? Answer: triangular prism
- I have two circular faces. I have a curved surface. Which geometric solid am I? Answer: cylinder
- I have an even number of vertices. I have the same number of faces and vertices. Which geometric solid am I? Answer: triangular pyramid

Launch – The students will use the knowledge they gained about geometric solids the previous day to create a model town.

Teacher Facilitation – The teacher will have the students brainstorm the different parts of a town. The students will be in groups and do the cooperative learning activity round table. Each student will write an important part of a town on a piece of paper and then pass the paper and pencil to the next person. The teacher will give the students five minutes to come up with as many parts of a town as they can. After five minutes the teacher will have the groups share the parts they came up with without repeating what another group has shared. Some examples of parts of a town are housing development, shopping center, school, hospital, library, post office, airport, and park. Some parts of a town could be combined to give each group the same amount to create. The teacher will pick the five or six most important parts and have the groups each create that part of the town. The teacher will model how to create the geometric solids out of gumdrops and toothpicks.

Student Application – Have each group get out their geometric solids from the previous day to refer to when making the gumdrop figures. Assign each group a part of the town by pulling the names out of a hat. Make the students aware of the requirements of the town. They must use the gumdrops to create geometric solids. They must use each geometric solid at least twice when creating their part of town. Before beginning each group will discuss what part each person in the group will be making. The teacher will walk around and help groups of students to assign jobs and create their parts of town. Ask questions to help them problem solve while creating their buildings. Make sure students are working cooperatively. After they have created their part of town, have students write about the figures they used to create their building and why they chose those figures.

Embedded Assessment – Observe each student as they are working in their groups to see how he/she is progressing. Do they understand how many faces, edges, and vertices are needed to make their figure? Are they using the toothpicks and gumdrops correctly to make the geometric figures? Is each group making at least two of each figure?

Reteaching/Extension –

- For those students and/or groups who do not understand how to create the solid figures, show them a solid figure and ask them what they need to create the figure. Have them identify the faces, edges, and vertices in their figure.
- If the students did not make two of each geometric figure in their part of the town, help them to change some of their buildings to meet the requirements.
- If students complete their part of the town, have them continue to make other parts of the model town not assigned to other groups.

Summative Assessment:

The students will be given a worksheet with two shapes. They will have to identify and compare the two shapes using their attributes.

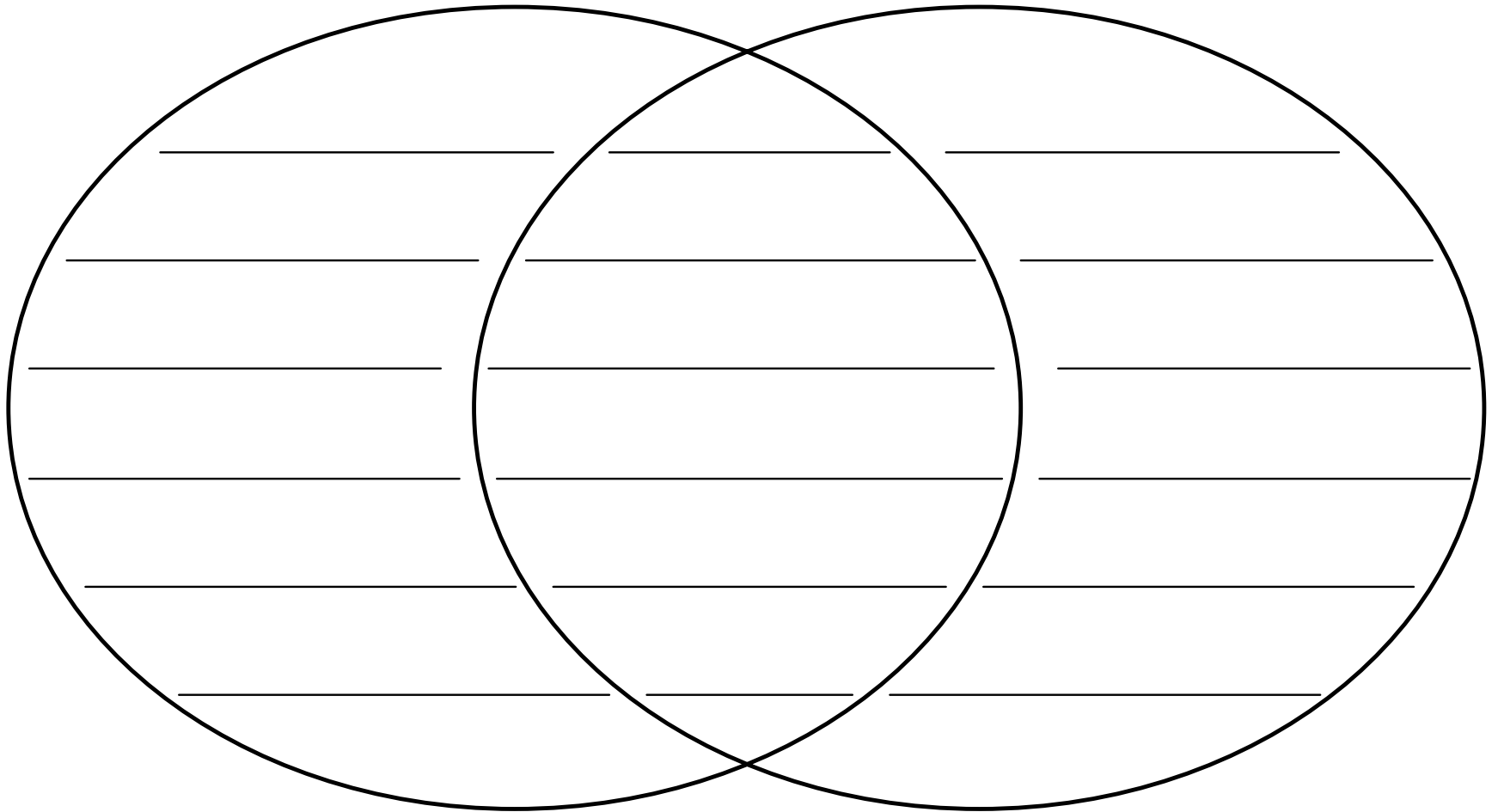
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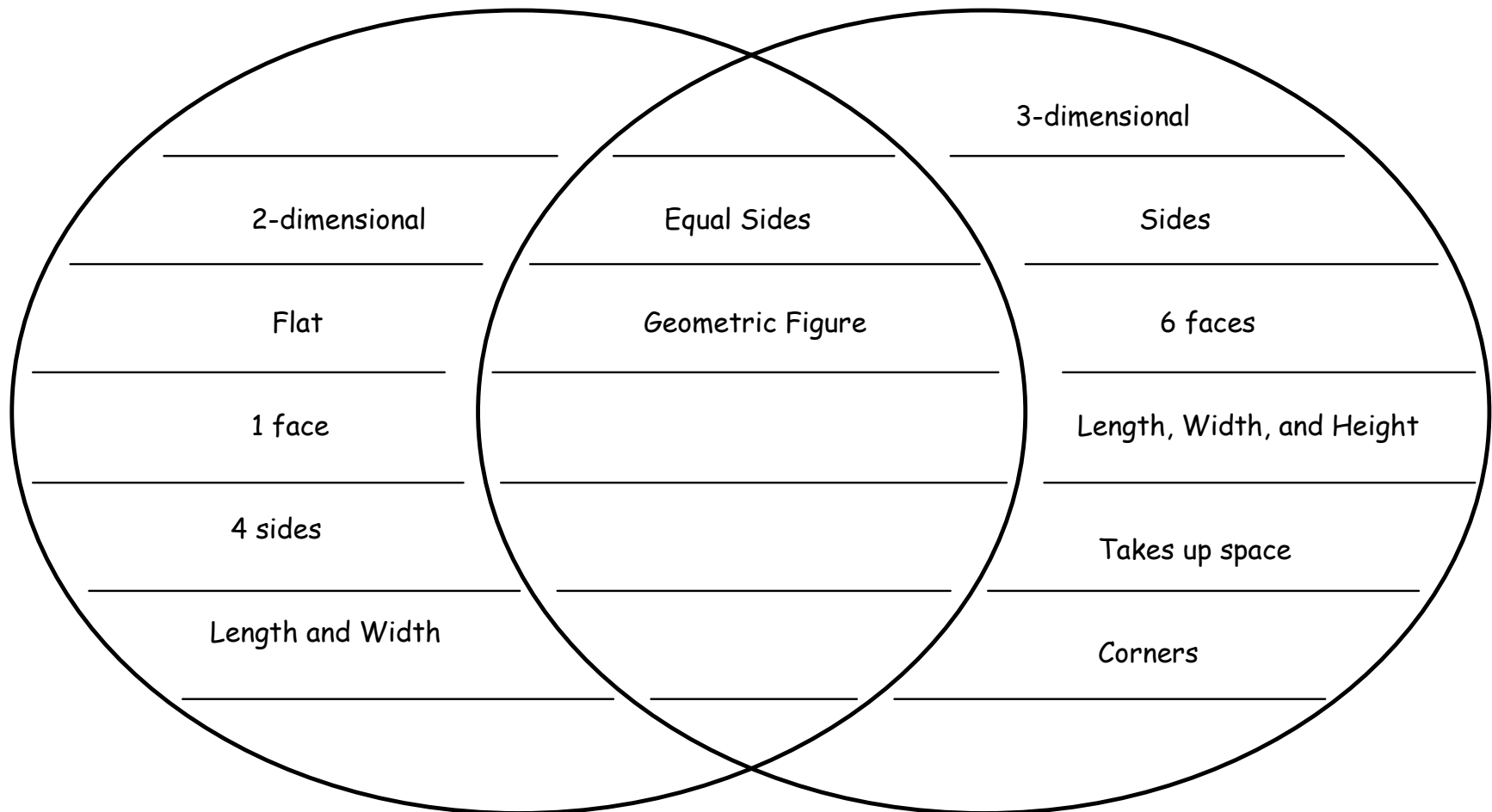
Square

Cube



Square

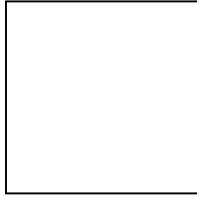
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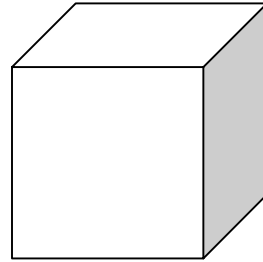


Name: _____ Date: _____

Exit Card – Lesson 1, Exploring Solid Figures

Label the following shapes as 2-dimensional or 3-dimensional.





Explain why your answer is correct. Be sure to include
information you learned today in your explanation.

Response Cards for Lesson 2 Preassessment

Directions: Cut out and glue on color-coded index cards. Have students display appropriate cards as you show on different solids.

FACE

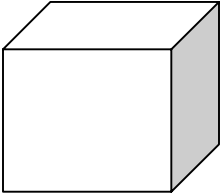
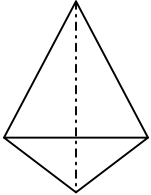
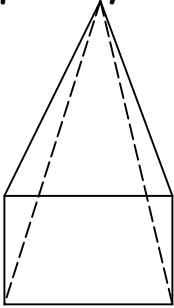
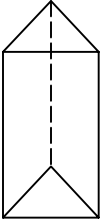
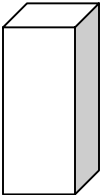
VERTEX

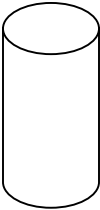
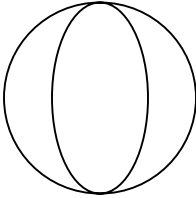
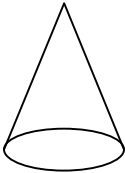
EDGE

Name: _____

Date: _____

Geometric Solids Attribute Chart

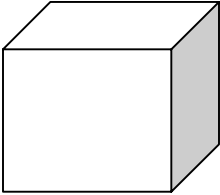
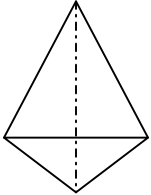
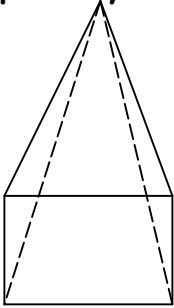
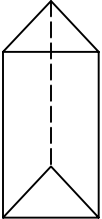
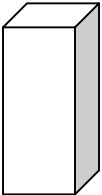
Solid	Number of Faces	Shape(s) of Face(s)	Number of Vertices	Number of Edges	Where in the World?
Cube 					
Triangular Pyramid 					
Square Pyramid 					
Triangular Prism 					
Rectangular Prism 					

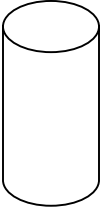
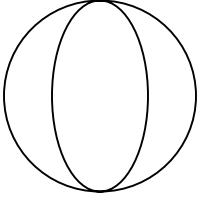
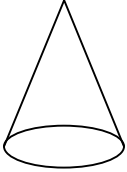
<div>Cylinder</div> <div></div>					
<div>Sphere</div> <div></div>					
<div>Cone</div> <div></div>					

Name: _____

Date: _____

Geometric Solids Attribute Chart

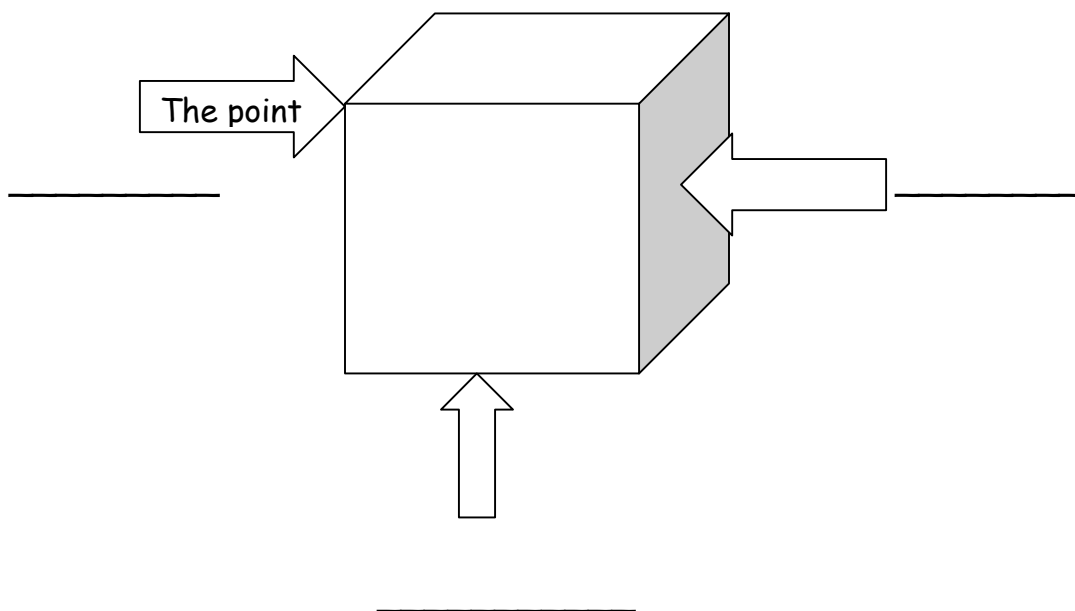
Solid	Number of Faces	Shape(s) of Face(s)	Number of Vertices	Number of Edges	Where in the World?
Cube 	6	square	8	12	
Triangular Pyramid 	4	triangle	4	6	
Square Pyramid 	5	triangle and square	5	8	
Triangular Prism 	5	rectangle and triangle	6	9	
Rectangular Prism 	6	rectangle and square	8	12	

Cylinder 	2	circle	0	0	
Sphere 	0		0	0	
Cone 	1	circle	1	0	

Name: _____ Date: _____

Exit Card - Lesson 2, Exploring Geometric Solids

Label the face, vertex, and edge on the cube.

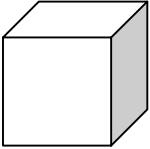
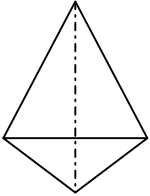
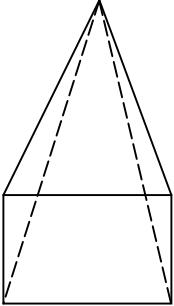
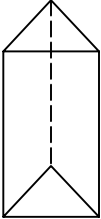



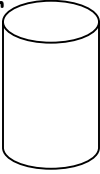
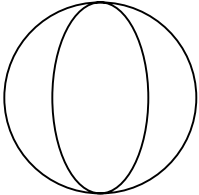
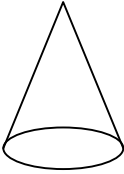
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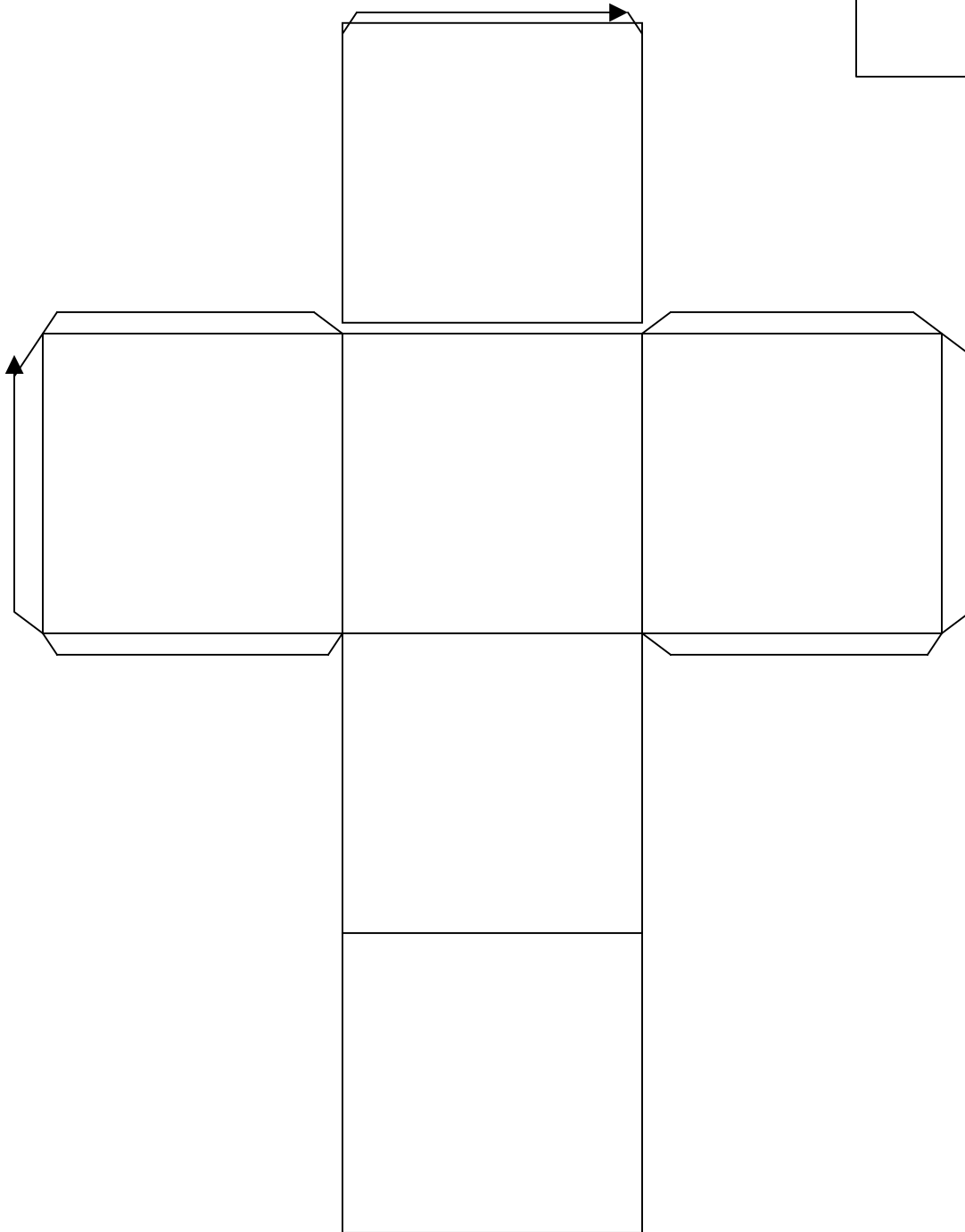
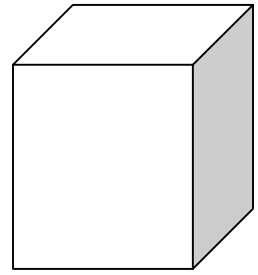
Finding Geometric Solids - Homework

Directions: Locate the following geometric solids in your world. Look for these solids in different places in your home, backyard, and even school. Write the items you found next to the solid figure.

Solid	Item(s)
<p>Cube</p> 	
<p>Triangular Pyramid</p> 	
<p>Square Pyramid</p> 	
<p>Triangular Prism</p> 	

<p>Rectangular Prism</p> 	
<p>Cylinder</p> 	
<p>Sphere</p> 	
<p>Cone</p> 	

Cube Net



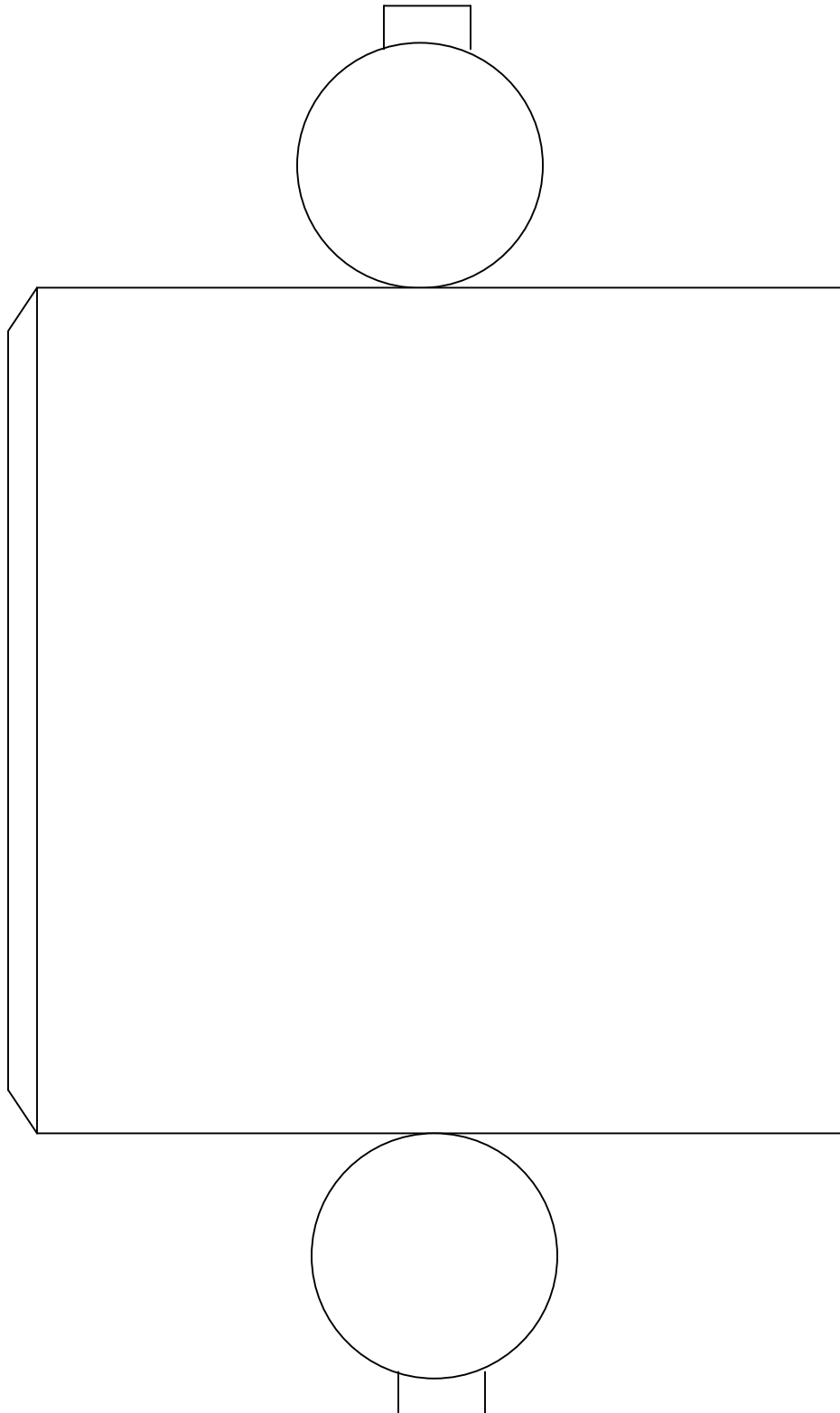
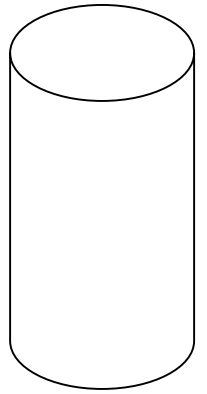
Cut along the solid outside line. Do not cut off the tabs!
Fold on the inside 5 lines.
Glue or tape the tabs together to make a cube.

Cylinder Net

Cut along the solid outside line. Do not cut off the tab!

Roll the rectangle to form a cylinder

Glue or tape the tab to the other side of the rectangle to make a cylinder.

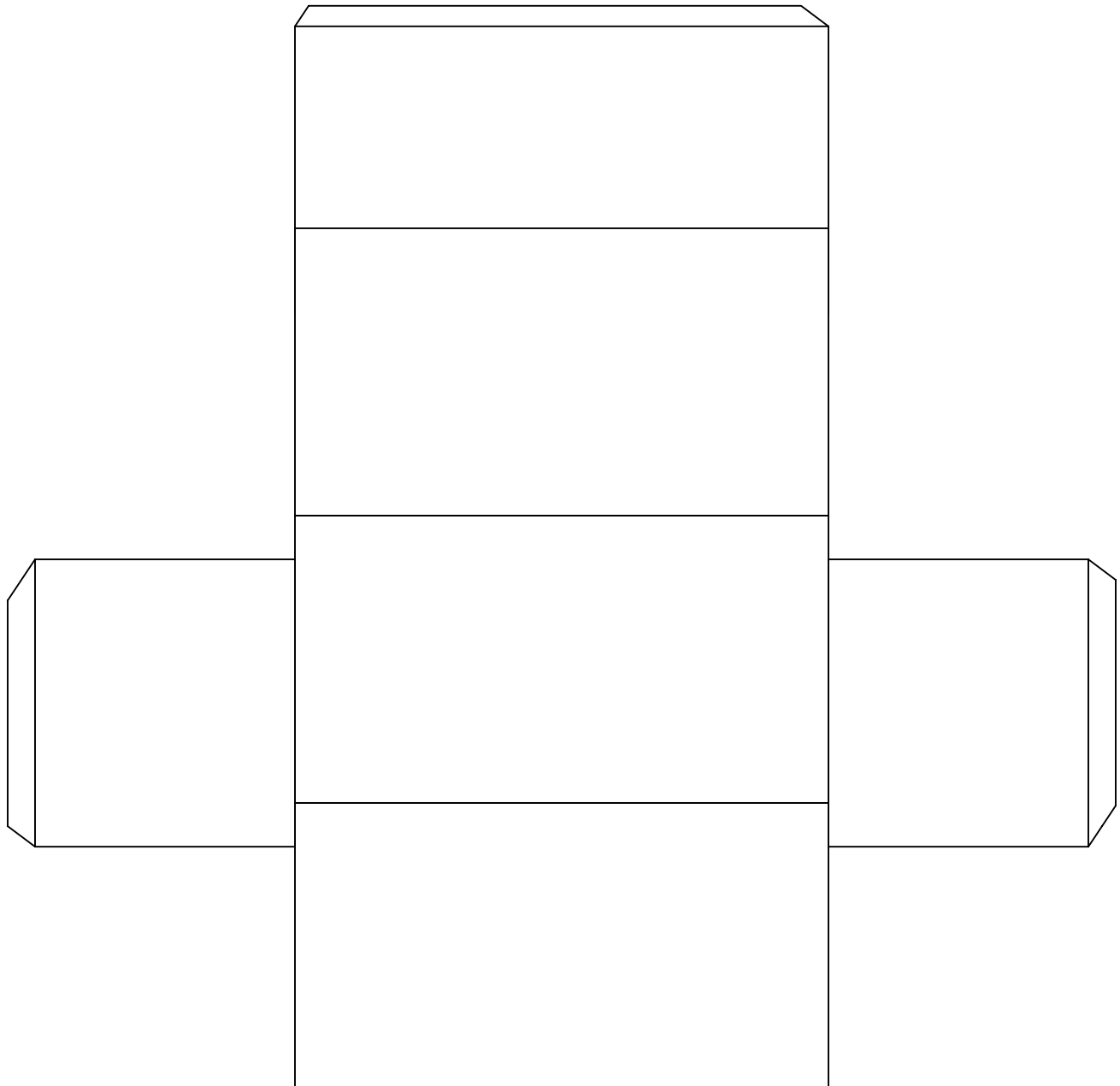
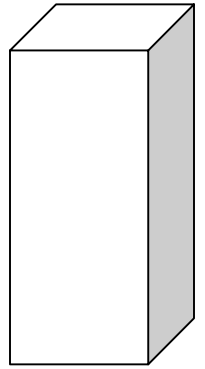


Rectangular Prism Net

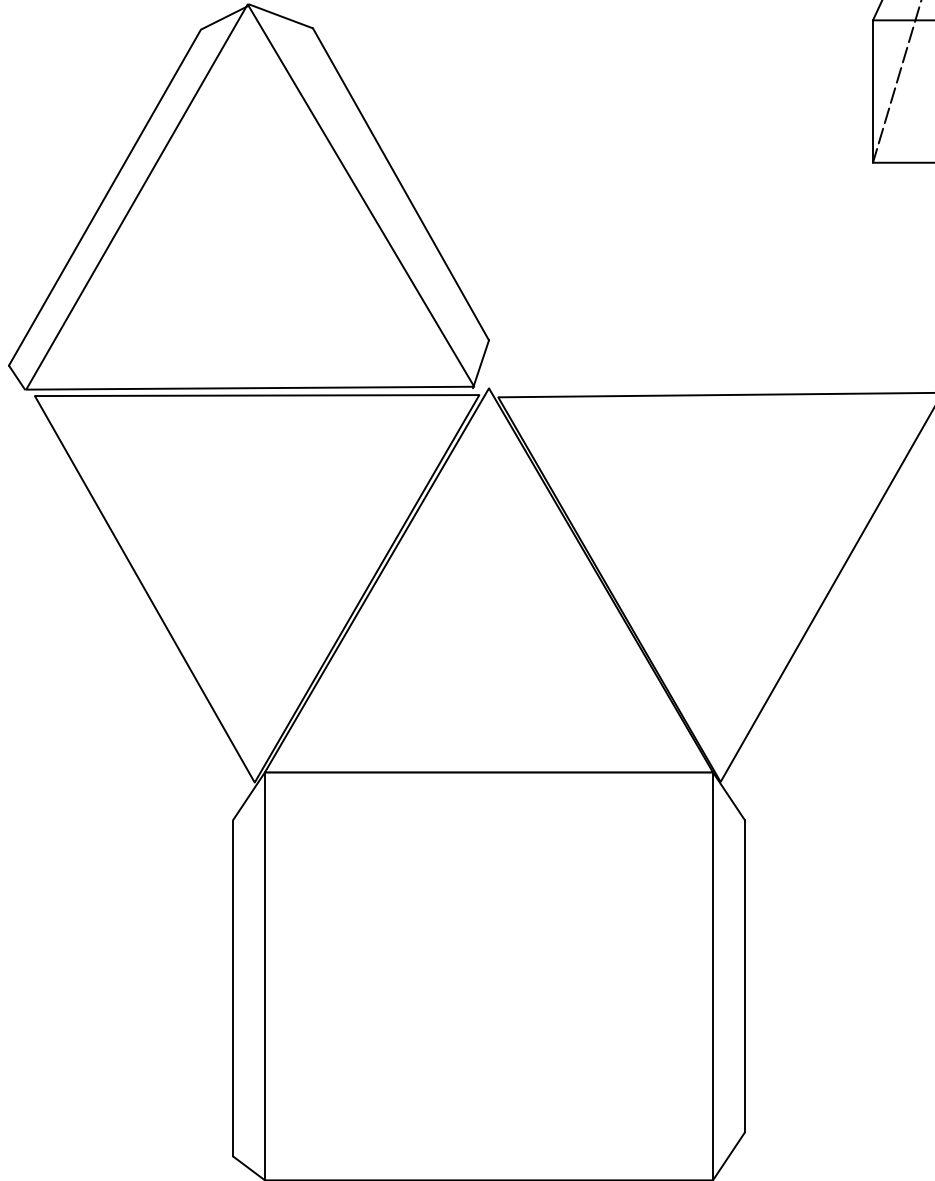
Cut along the solid outside line. Do not cut off the tabs!

Fold on the inside 5 lines.

Glue or tape the tabs together to make a rectangular prism.

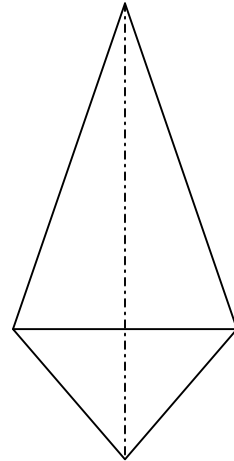
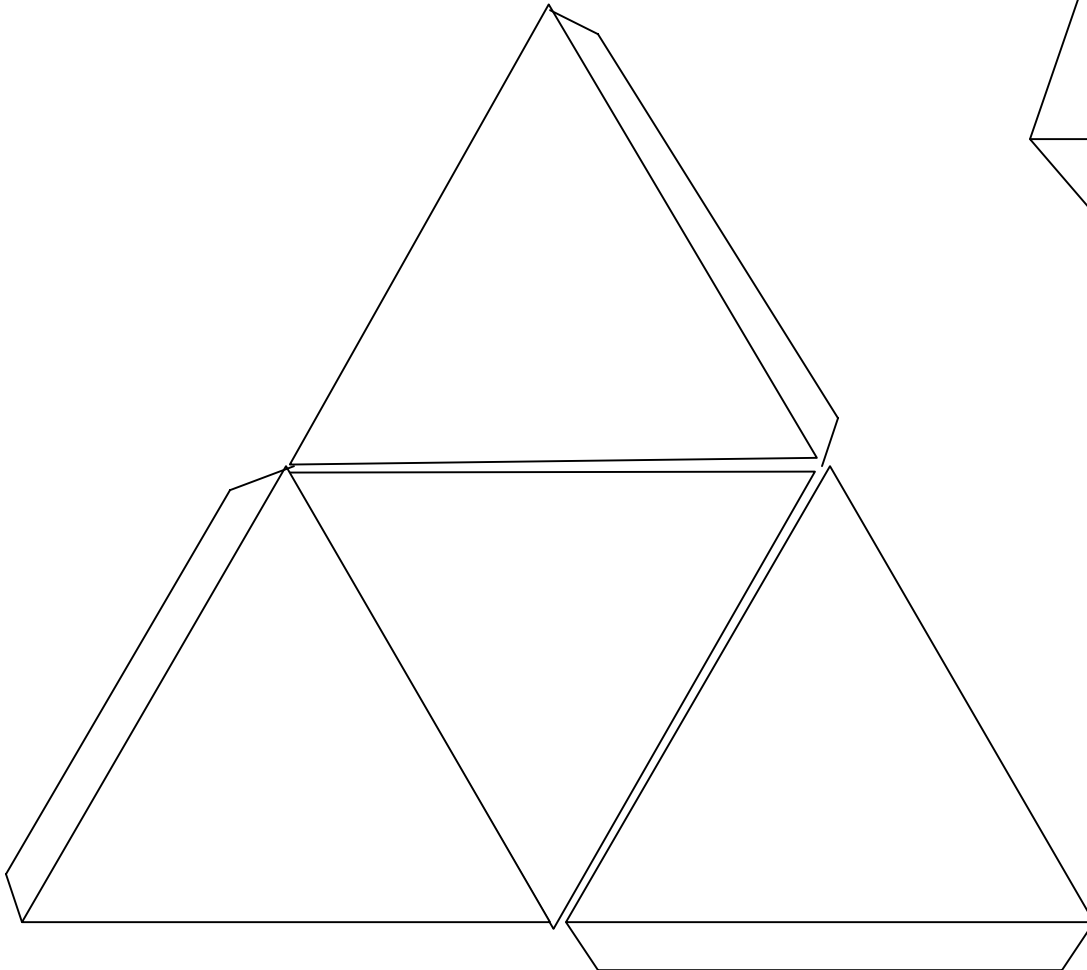


Square Pyramid Net



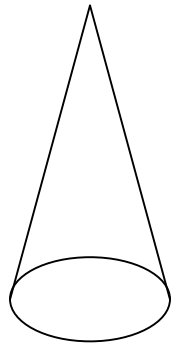
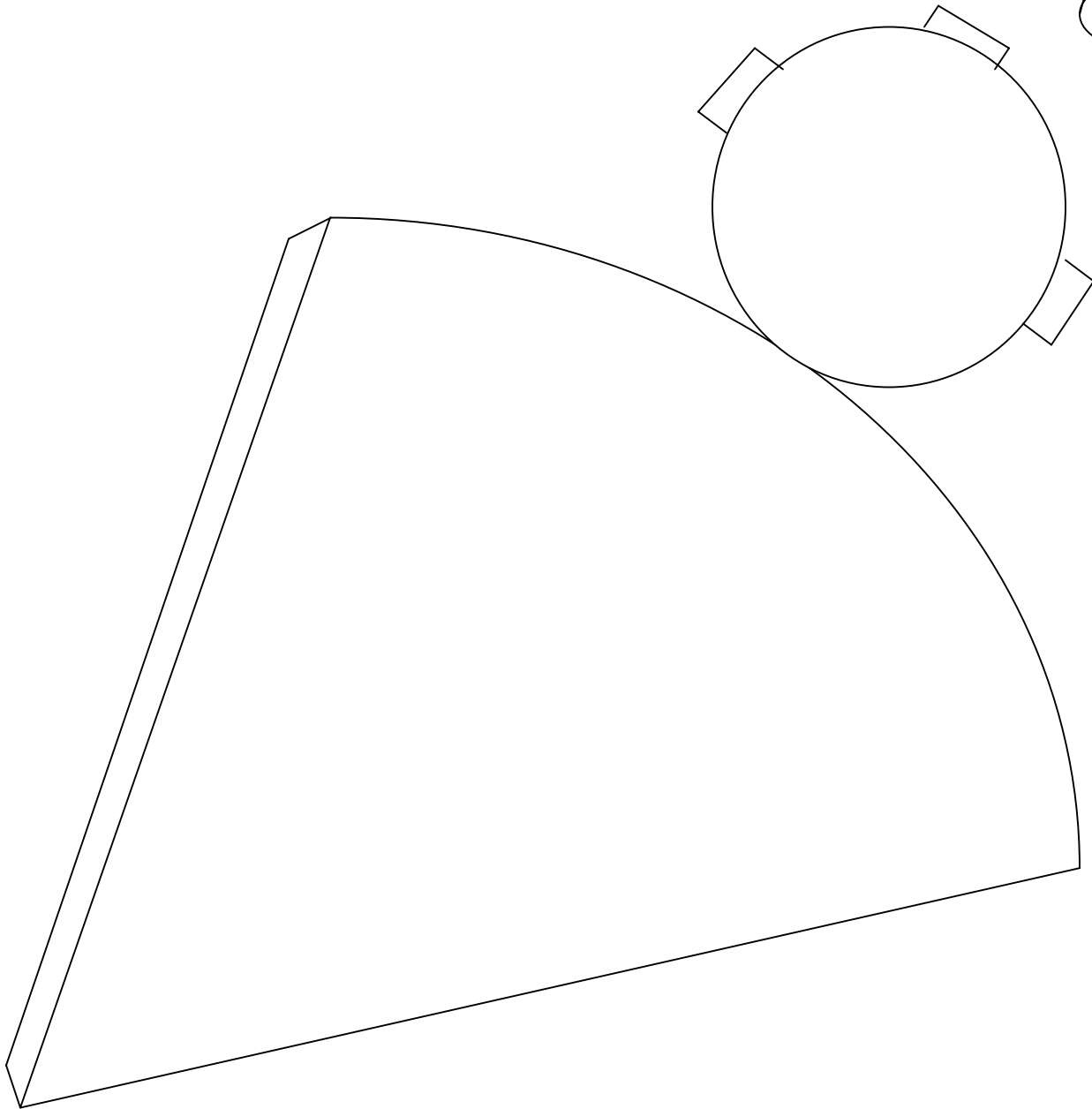
Cut along the solid outside line. Do not cut off the tabs!
Fold on the inside 4 lines.
Glue or tape the tabs together to make a square pyramid.

Triangular Pyramid Net



Cut along the solid outside line. Do not cut off the tabs!
Fold on the inside 3 lines.
Glue or tape the tabs together to make a triangular pyramid.

Cone Net



Cut along the solid outside line. Do not cut off the tabs!

Roll the triangle to make a cone

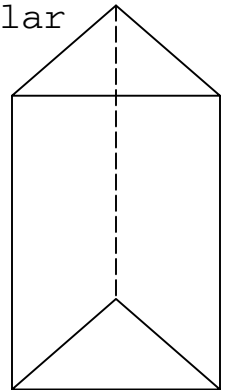
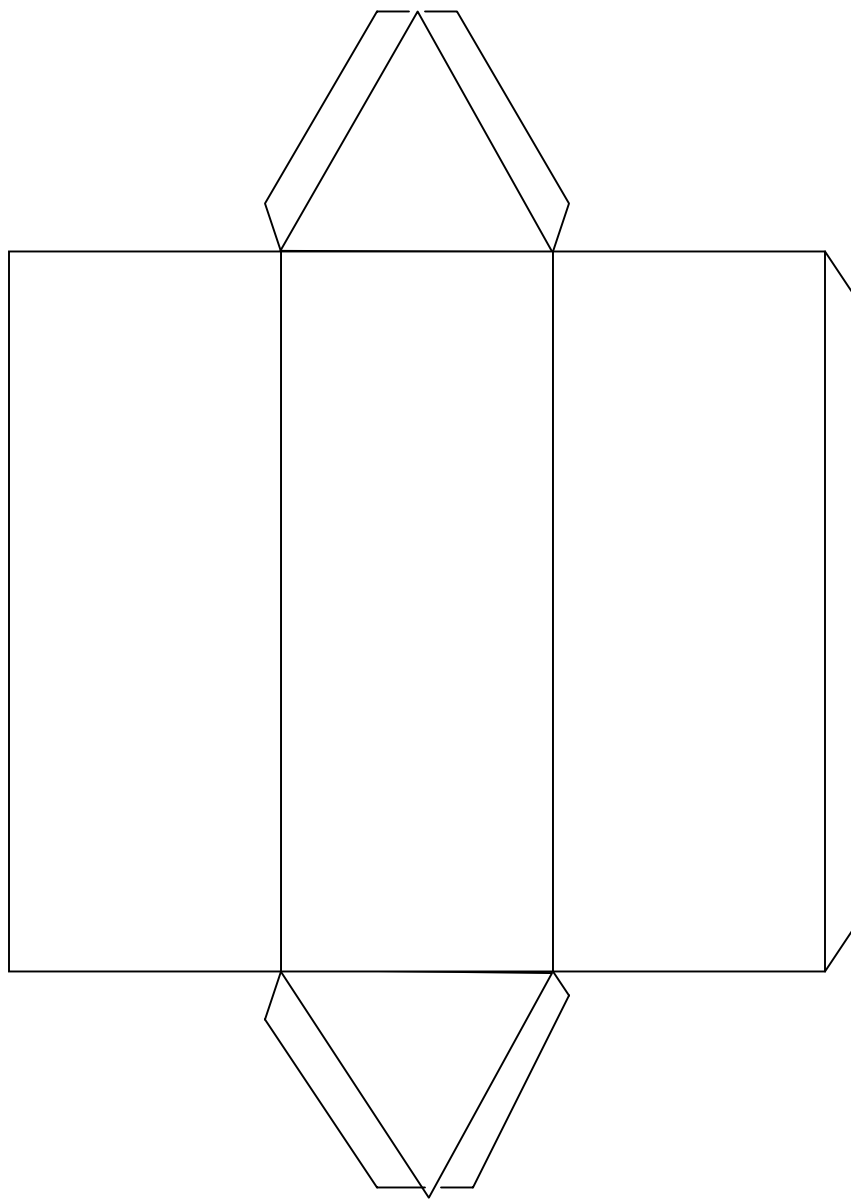
Glue or tape the tabs together to make a cone.

Triangular Prism Net

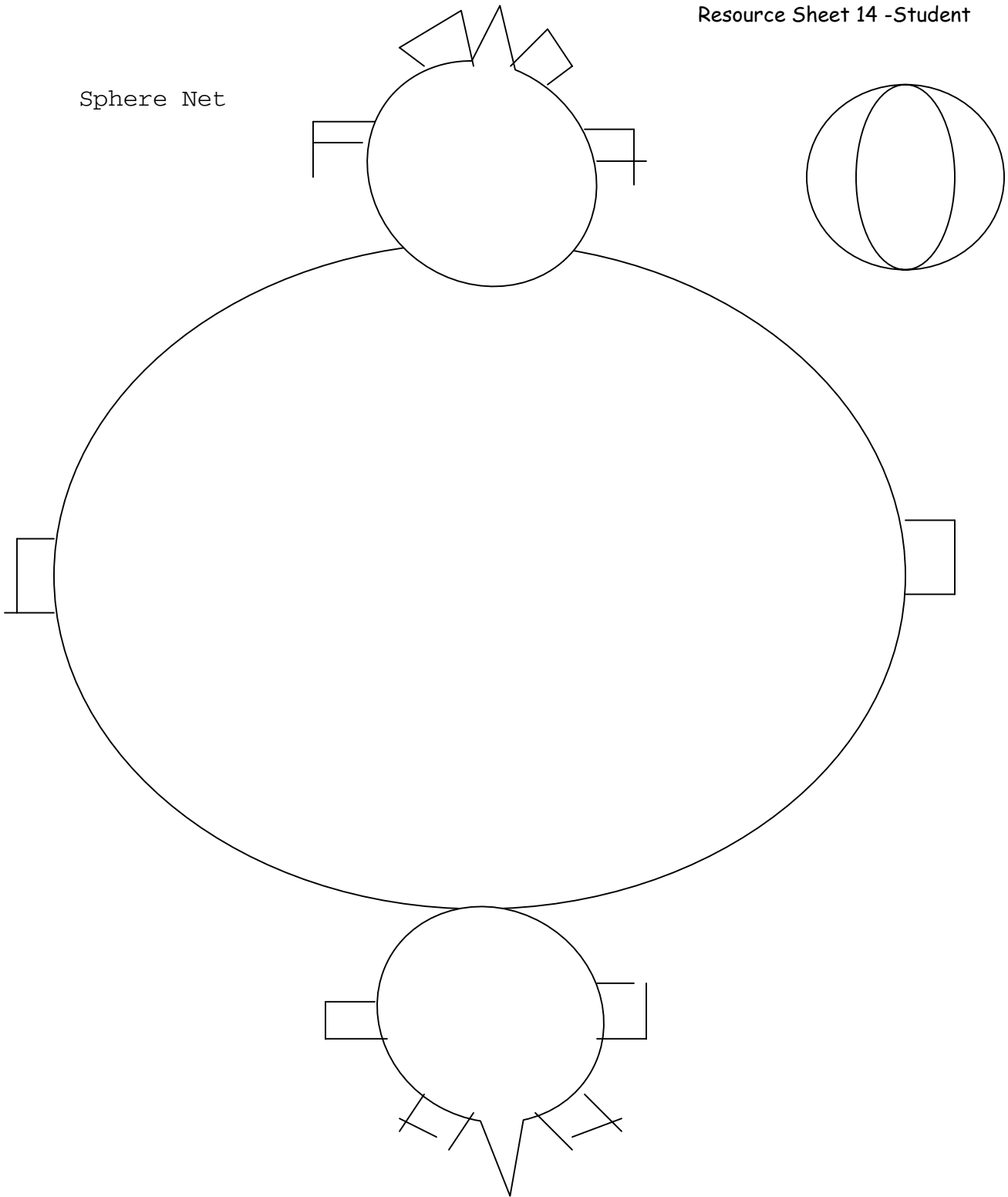
Cut along the solid outside line. Do not cut off the tabs!

Fold on the inside 4 lines.

Glue or tape the tabs together to make a triangular prism.



Sphere Net



Cut along the solid outside line. Do not cut off the tabs!

Roll the oval to form a sphere.

Glue or tape the tabs together to make a sphere.

Name: _____ Date: _____

Illustrate one of the buildings you made for your group's part of the town.

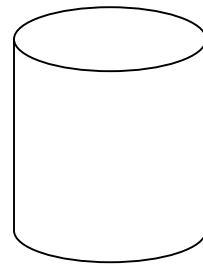
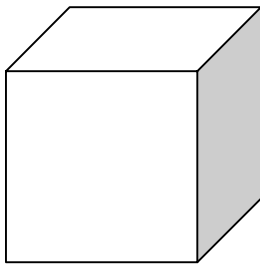
Write about one of the geometric solids you chose to use in your model. Why did you use that solid? What characteristics does that geometric solid have?

Name : _____

Date: _____

Geometric Solids

1. Identify the following solid figures.
2. Compare these two figures using their attributes. Before you write, think about the faces, edges, and vertices of both shapes.

[illegible]

Geometric Solids - Summative Assessment Rubric: (Earn a total of 4 points)

1. 2 points: Student identified both figures correctly.
 1 point: Student identified one figure correctly.
 0 points: Both figures identified incorrectly.

2. 2 points: The response demonstrates a complete understanding and analysis of a problem.
 - Response uses the terms face, edge, and vertex to compare figures.
 - Response names the number of faces, edges, and vertices correctly.
 - Response makes the connection that figures are 3-dimensional and contain 2-dimensional shapes as faces.

- 1 point: The response demonstrates a minimal understanding and analysis of a problem.
 - Response uses some of the terms face, edge, and vertex, but does not use to compare and contrast.
 - Response uses the terms face, edge, and vertex, but does not name the numbers correctly.
 - Response makes partial connection between 3-dimensional figures and 2-dimensional shapes as faces.

- 0 points: The response is completely incorrect, irrelevant to the problem, or missing.